

Revised Sep 1998

PART 8

ELECTRICAL

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## I. CONCEPT DESIGN:

### A. General:

1. The concept submittal need not provide extensive details but shall be complete enough to thoroughly express the designer's intentions.

2. A trip report of the visit to the site shall be provided. A statement explaining the source of information (name and title) about the capacity of existing circuits and any directions received shall be provided.

### B. Design Analysis (Narrative):

#### 1. Exterior Electrical Distribution System:

a. Provide a brief description (narrative) of the exterior electrical distribution system according to the format indicated by paragraphs E and F "Electrical Concept and Final Design Narrative Outline" (attached EXHIBIT E-1). Any items listed that are not applicable to this project may be deleted and any items applicable that are not listed must be shown.

b. Provide a separate electrical site plan indicating all existing and proposed support utility lines required to serve the project including electrical power supply and lines, and all telephone and other communication lines. It shall also show all roads and driveways, parking areas, and any other items necessary for functional and operating adequacy.

c. Provide electrical characteristics (voltage, phase, number, and size of conductors) for power supply and/or primary and secondary lines at the point of delivery and extensions. Indicate characteristics and standards of design for overhead or underground line. Include justification for underground line.

d. Estimate the total connected load and resulting demand load by applying demand and diversity factors for loads involved. Indicate type, number of units, KVA capacity, and primary and secondary voltage of the transformer installation proposed, including primary and secondary connections of transformers. Also show primary and secondary voltage drop and size of primary and secondary distribution conductors proposed to serve the load.

e. Indicate intensity and type of exterior lighting proposed (street lighting, security lighting, or parking lot lighting).

## 2. Interior Electrical Distribution System:

a. Provide a narrative description of the electrical systems which will be developed by design, or a list of requirements to upgrade design analysis, drawings, and the specification section to "site adapt" an existing design according to the format indicated by paragraphs A-D in the "Electrical Concept and Final Design Narrative Outline" (attached EXHIBIT E-1). Any items listed that are not applicable to the project may be deleted and any items applicable that are not listed must be shown.

b. Include a concept lighting schedule showing room name and/or number, lighting intensity, type of fixture (by standard drawing number or catalog number), voltage, and basis of design such as I.E.S., etc. Use the table as shown by attached EXHIBIT E-2 or an equivalent lighting calculation software package.

c. Include a concept special power outlet schedule showing room name and/or number, phase, voltage, amps, frequency, hazardous classification, and NEMA configuration. Use the table as shown by attached EXHIBIT E-3.

d. Address fire alarm, telephone, CCTV, IDS, EMCS communications (LAN, intercom, PA, etc.) and special requirements (grounding, filters, shielding, etc.).

e. IDS and EMCS shall be coordinated through the Baltimore District Engineering Division IDS and EMCS technical coordinator.

## 3. Outline Specifications:

a. The outline specifications shall consist of a listing of specification titles which shall be used. Corps of Engineers Guide Specifications (CEGS) shall be listed first, followed by titles for which there are no CEGS. Each specification section title shall be followed with:

b. A list of proposed Deviations (see ER 1110-345-720) to Corps of Engineers Guide Specifications. Related manufacturer's information shall be attached.

c. If the specification sections for which there are no CEGS are already developed, such as sections which are to be tailored from other projects, untailored copies may be included here or attached.

4. Additional information or material required to complete design shall be listed, or a statement shall be made that none is needed.

5. Include a statement reflecting coordination with the local DOIM and USAISEC-CONUS, FT. RITCHIE, MD.

6. Energy conservation measures shall be indicated. The electrical designer shall be a team member for energy budget preparation and shall provide necessary information to the architect and mechanical designers for inclusion in the energy budget.

## II. PRELIMINARY DESIGN:

A. General: The preliminary submittal shall consist of design analysis, drawings, and outline specifications as described below.

### B. Design Analysis:

1. Interior Electrical Work: Determine estimated loads, main feeder wire sizes, main switch, service entrance and transformer sizes, including photometric calculations. (Individual circuit load tabulations and interior voltage drop calculations are not required for the preliminary design analysis). Economic considerations, equipment selection, emergency power requirements (generator, lighting, etc.) and seismic zone.

2. Exterior Electrical Work: Determine estimated primary and secondary wire sizes and transformer sizes. Discuss exterior utilities (UG/OH, telephone, CCTV, etc.).

### C. Preliminary Drawings:

#### 1. Exterior:

a. Exterior Electrical Layout Plans: Exterior electrical layout plans are required and shall be separate from water, sewage, and other utility plans. Other new or existing utilities shall be shown only as required to prevent conflicts with the electrical work. As a minimum show on preliminary drawings:

1. Location and type (aerial or underground) of all new primary and secondary lines, transformers, and service drops.

2. Poles and equipment to be relocated or removed. Clearances from buildings shall be in accordance with the National Electric Safety Code.

3. New location of any relocated electrical items.

4. Type of new construction whether aerial or underground for both primary and secondary, and conductor material (CU, ACSR, etc.).

5. Accurate location and sizes of the existing lines including poles and transformers from which power is to be obtained.

6. Proposed wire sizes and transformer sizes.

7. Exterior telephone UG/OH designed in accordance with TM 5-811-9, Voice/Data Telephone Systems.

b. Other electrical features as applicable.

## 2. Interior:

a. Interior plans are required for all new designs. As a minimum show on all new interior preliminary drawings:

1. Designation of all rooms, room numbers, graphic scales, north arrows and work areas by name as shown on architectural or other drawings.

2. Attachment point for service drop.

3. Location of main switch, power distribution panels and lighting panels.

4. Location and type of lighting fixtures to be installed in each area, and quantity of each type of fixture.

5. Special features such as increased neutral/ filter/voltage regulator/special grounding/isolation/surge protection for computers, underfloor raceways, clock system, fire alarm system, exit lighting system, bus duct, communication facilities, IDS, EMCS, shielding and other quipment/systems in hazardous locations.

6. Riser diagrams showing service equipment feeders, fire alarm systems, telephone systems, panels, and estimated sizes of these and other similar items.

7. Interior wiring conduit system only.

8. Provide an interior telephone system consisting of cable, conduits, cabinets, outlets, etc., designed in accordance with TM 5-811-9, Voice/Data Telephone Systems.

9. The Standard Lighting Fixture Details as indicated on Standard Detail No. 40-06-04 may be referred to by sheet number only if the detail fits the exact situation. If modification to a detail is necessary, provide a detail description of the intended modification or special fixture to be provided. These details can be found on the COE web page at: [http://mroed-d\\_3.mro.usace.army.mil/guides.htm](http://mroed-d_3.mro.usace.army.mil/guides.htm).

10. Location, electrical characteristics, and horsepower (if applicable) of electrical equipment.

#### D. Outline Specifications:

1. Prepare outline specifications based on the applicable guide specifications.

2. Indicate types of cables and conductors to be used.

3. Describe major items of equipment with sufficient clarity to permit a definite selection from catalog data for estimating purposes.

4. Where no guide specification sections or standard specification sections are provided, prepare a new outline specification from available criteria and instructions giving all pertinent material characteristics.

### III. FINAL DESIGN:

A. Design Analysis: Design analyses will be prepared in accordance with ER 1110-345-700 and the applicable engineering manuals for design of electrical features of the projects.

1. Short-circuit calculations shall be made to determine rating protective equipment and bus bracing for panelboards, switchgear, motor control centers, etc. In all cases available symmetrical shortcircuit current at the service equipment shall be indicated. (If more accurate data is not available, assume infinite bus on the primary and also consider motor contribution to fault current.)

2. Where connections are made to existing transformers or load centers, data shall be furnished regarding existing loading and method of determining the availability of sufficient capacity to carry the additional load.

3. Final design analysis shall include photometric calculations used to determine the number, type, and wattage of fixtures used in the final design. Final design analysis shall also cover the following:

- a. Voltage drop calculations for feeders.
- b. Voltage drop calculations for large motor startup.
- c. Voltage drop calculations for service entrance.
- d. Voltage drop calculations for service drop and secondary conductors.
- e. Summary of all connected loads, demand factor, and demand load by circuit number of each panel. This includes spare circuits. See attached EXHIBITS E-4 and E-5. (AE may use his own standard lighting calculation sheets and panelboard schedules provided all information required by E-4 and E-5 are included.)
- f. Summary of panel demand loads, feeder sizes for all panels, diversity factor between panels, main switch fuse or circuit breaker trip size, service entrance size, service drop size and transformer size.

g. The minimum number of short-circuit calculations shall be included to verify proper selection of all fuses and circuit breakers falling within the scope of the project.

h. The source of all design factors, formulae and equations and the bases for all assumptions used in the design analysis shall be identified. Where required the neutral currents for non-linear loads, sound system calculations and computer-neutral, grounding, isolation, IR regulation, shielding should be part of the design analysis documents.

i. Answers to preliminary comments.

4. All designs shall be based on the most economical plan consistent with the engineering manuals and the type of building construction required by criteria.

5. Connected loads, wire sizes, main feeder, main switch, service entrance, transformer sizes, primary and secondary sizes shall be indicated on the final plans and in the design analysis.

6. Trade names are not allowed on the contract plans and specifications; however, for lighting fixtures and other equipment such as motor control centers, switch gear, bus duct, transformers (where special features are required), special receptacles, etc., the current manufacturer and catalog number of the equipment will be indicated in the Design Analysis.

7. Calculations for guys shall be made for all aerial construction and the required strength indicated on the drawings.

8. Generator and UPS sizing.

9. In TV Distribution designs, the Architect-Engineer shall provide calculations showing db losses through the proposed system to each outlet. A riser diagram shall be provided showing each amplifier, line splitter, tap off, outlet and cable. The type of cable used shall be identified. The calculation shall be made assuming Odb signal on the load side of the antenna.

10. FA coordination discussion (water alarm, etc.).

11. LAN.

12. Cathodic protection.



B. Final Drawings:

1. Final Exterior Electrical Drawings:

a. Details of pole lines, UG ducts, transition poles, manholes, handholds, guying and grounding.

b. Final electrical drawings shall show details showing clearances from communications circuits, clearance between circuits of same voltage and circuits of different voltages, and distances from transformers and other equipment and buildings.

c. Fixtures, poles, foundation and grounding details for exterior lighting.

d. Provide sufficient construction details on the contract drawings for the exterior work, clearly distinguishing new from existing construction.

2. Final Interior Electrical Drawings: Final interior electrical drawings shall show the following:

a. A light/equipment, panel, motor control Fixture Schedule on the drawings.

b. Complete electrical wiring details.

c. Riser diagram indicating connections, protective relaying and wiring to main switch, distribution, power, motor control centers, M-G sets, generators, UPS's and lighting panels.

d. Sufficient details for mounting fixtures and equipment. Include seismic mounting details of fixtures and equipment grounding details (if required).

e. Horsepower ratings of all motors shall be shown.

f. Size of disconnect/starters.

g. Provide on the drawings a panel and switch schedule, in accordance with EXHIBIT E-5 or the designer standard schedule with equivalent information.

h. Provide complete riser diagrams for telephone P.A., intercom fire alarm and other communications systems.

i. Designation of all rooms and areas as shown on architectural and other drawings.

j. Metering shall be provided.

k. Symbol legend.

l. Graphic scales, north arrows.

#### C. Final Specifications:

1. Items not covered, or only partially covered in guide specifications, shall be fully specified.

2. Special equipment shall be thoroughly described.

3. For each luminaire of the Lighting Fixture Schedule, for which there is no corresponding sheet of Standard Detail No. 40-06-04, provide a detail on the drawings, and provide a description in specification section or on the drawings which is similar to the descriptions contained on the several sheets of Standard Detail No. 40-06-04.

#### IV. DESIGN CRITERIA:

A. Technical Instructions TI 800-01 from CEMP-E, dated 20 Jul 1998 (and all current changes), are to be used replacing Architect Engineering Instructions (AEI) for all U.S. Corps of Engineers designs except medical facilities which are governed by AEI, Medical Design Standards. These TI are available at the U.S. Army Corps of Engineers TECHINFO web address:  
<http://www.hnd.usace.army.mil/techinfo/index.htm>.

B. Electrical work includes, but is not limited to, the design of the following systems:

1. Secondary Power Supply and Distribution.

2. Primary Power Supply.

3. Lighting.

4. Grounding.

5. Fire Alarm.
6. Security.
7. Communications.
8. Cathodic protection, lightning, EMCS.

C. Coordination of Work: Coordinate lighting layout, space requirements, conduit routing and the like with architectural, structural, mechanical design elements. Exterior electrical distribution systems will be coordinated with other exterior utility design and site work elements.

D. Basic Design Criteria:

1. See above. Technical Instructions TI 800-01, dated 20 Jul 1998 is the prime design manual. For Army projects various manuals in the TM 5-811 series supplement it. In case of conflict the Architectural and Engineering Instructions govern; or if unable to determine, contact the Baltimore District Office. Communication systems shall be in accordance with ER 1110-3-110, 15 Oct 1991; and TM 5-811-9, Voice/Data Telephone Systems.

2. On any project for NSA (National Security Agency), the plans and/or specifications should require a secure manhole frame and cover for all communication and electrical manholes. The type of manhole specified shall be a Neenah Catalog No. R-1751-C. No substitutions shall be allowed.

E. Design Analyses:

1. Design analyses shall be in accordance with ER 1110-345-700.

2. All designs shall be based on the most energy conservative and economical plan consistent with the pertinent criteria, instructions and engineering manuals.

3. In order to comply with UL's "Electrical Construction Materials Directory," conductor ampacity for sizes #14 thru #1 AWG shall be based on 60 C wire and conductor ampacity for sizes #1/0 AWG and larger shall be based on 75 C wire in accordance with table 310-16 of the National Electrical Code (See page 7 - "Distribution and Control Equipment Terminations" of the referenced UL document).

F. Standard References: The following is a list of the more commonly required electrical references:

1. Standard Details:

a. Standard Detail No. 40-06-04, Lighting Fixtures.

2. Standard Forms: (AE may use his own forms if all the information required by the exhibits below is shown.)

a. Panel and Switch Schedule (EXHIBIT E-5)

b. Lighting Schedule (EXHIBIT E-2).

c. Concept Special Power Outlets Schedule (EXHIBIT E-3).

d. Connected Load (EXHIBIT E-4).

G. Guide Specifications: The appropriate section of guide specifications will be requested by the Architect-Engineer for each project. The designer shall read each before design is started and pay special attention to General Notes and Technical Notes included with each section of guide specifications. The specifications and notes reflect criteria that must be incorporated in the design.

H. Energy Conservation: Full engineering considerations shall be given to achieve energy conservation. Several considerations to achieve energy conservation are described in the Architectural and Engineering Instructions dated 03 Jul 1994. All computer based automation systems, regardless of size or purpose, which sense the physical environment and/or control equipment in real-time shall not be included in any design without prior approval of the Engineering Division, Energy Monitoring and Control System (EMCS) Technical Coordinator at or before the concept submission. The current EMCS Technical Coordinator is John Kelly, CENAB-EN-D, (410) 962-3881.

I. Primary Electrical Distribution Systems:

1. Aerial Systems: Construction details for aerial construction shall be consistent with modern practices. Pole framing details shall generally follow those employed by the power company serving the general locale of the installation and as shown in TM 5-811-1. All designs shall be consistent with the requirements of A.N.S.I. C2, National Electrical Safety Code.

2. Underground Systems: Generally all underground primary conductors shall be installed in concrete encased ducts unless indicated otherwise in the Specific Instructions to Architect-Engineer, or other detailed criteria for the project.

\*\*\*END\*\*\*

ELECTRICAL CONCEPT AND FINAL DESIGN NARRATIVE OUTLINE:

A. GENERAL:

- Sheet.
1. Estimated Demand Load: Demand Load Summary
  2. Hazardous Locations.
  3. Lightning Protection including risk factor calculations.
  4. Cathodic Protection Considerations
  5. Design Criteria.
  6. Seismic Requirements.
  7. EMCS Design Considerations.
  8. Work Required for "Site Adapt".
  9. Physical handicap considerations.

B. INTERIOR LIGHTING:

1. General.
2. Task.
3. Accent.
4. Emergency and Exit Lighting.
5. Special.

C. INTERIOR POWER:

1. General.
2. Emergency (generator, UPS, battery).
3. Special.

D. SPECIAL SYSTEMS (INTERIOR):

1. Telephone.
2. Intercom System.
3. Sound Masking System.
4. Paging, P.A. and Background Music Systems.
5. Security System.
6. C.C.T.V. and M.A.T.V.
7. Clock and Program Bell System.
8. EMCS.
9. LAN.
10. Fire Alarm System.
11. Grounding, filtering, shielding.

E. EXTERIOR LIGHTING:

1. Parking Area Lighting.
2. Security Lighting.
3. Special Lighting.

F. EXTERIOR POWER:

1. Transformer.
2. Duct System.
3. Service Entrance.
4. Parking Area Lighting Power.

G. EXTERIOR UTILITIES:

1. Telephone.
2. LAN.
3. CCTV.



